

PATENT

What is claimed is:

1 1. A process for automatically altering the data rate on a logical channel with
2 changing noise conditions, comprising the steps:
3 1) resetting a flawed packet counter for said logical channel;
4 2) resetting a total packets received counter for said logical channel;
5 3) receiving a packet on said logical channel, and incrementing the total packet
6 received counter;
7 4) processing error detection data in said packet to determine if there is an
8 error in the packet, and, if so, incrementing said flawed packet counter;
9 5) comparing the count in said total packet counter to a number representing
10 the desired number of packets to be received before a determine of packet loss
11 percentage is made;
12 6) if the number of packets received is less than the desired number, returning
13 to step 3;
14 7) if the number of packets received is equal to or exceeds the desired
15 number of packets received, calculating a packet loss percentage by dividing the
16 number of flawed packets by the total number of packets received;
17 8) comparing the packet loss percentage calculated in step 7 to one or more
18 packet loss thresholds;
19 9) determining if a change in date rate throughput is required based upon the
20 comparison(s) made in step 8;
21 10) if a change in date rate throughput is required, generating a signal
22 indicating the need for a change in data rate for said logical channel.

1 2. The process of claim 1 further comprising the steps of determining in step 3 if an
2 incoming packet is transmitted in response to a contention grant, and, if said packet is
3 transmitted in response to a contention grant, discarding said packet and not incrementing the
4 packet received counter or the flawed packet counter, and further comprising a step 11
5 comprising the substeps of either selecting a new burst profile with an appropriate date rate
6 throughput and generating and transmitting a upstream channel descriptor message setting
7 new data rate throughput parameters of said selected burst profile, or selecting a new burst
8 profile and generating a visible or audible notification to a system operator informing of the

PATENT

9 need for a change in data rate throughput and suggesting the new burst profile that should
10 be used, and returning to step 1 for a new logical channel.

1 3. The process of claim 1 further comprising a step performed before any
2 processing to determine if an operator has turned automatic rate adaptation on for all logical
3 channels.

1 4. The process of claim 1 further comprising a step performed before any
2 processing to determine if an operator has turned automatic rate adaptation on for the
3 particular logical channel to be processed.

1 5. The process of claim 1 further comprising the step of generating an upstream
2 channel descriptor message having descriptor data that defines a data rate that is different
3 from the existing data rate of said logical channel and appropriate to the currently existing
4 noise conditions, and transmitting said upstream channel descriptor message at least to all
5 cable modems that may be assigned to use said logical channel.

1 6. The process of claim 1 further comprising the steps:
2 if step 9 determines that a change in data rate throughput is not required,
3 returning to step 1 and begin processing for a new logical channel; and
4 if step 10 determines that a change in data rate is required, selecting a new
5 burst profile with a data rate which is changed appropriately for the current noise
6 conditions on said logical channel, and generating and transmitting an upstream
7 channel descriptor message that contains data that controls cable modems to transmit
8 using the changed data rate.

1 7. The process of claim 1 wherein steps 8 and 9 further comprise:
2 A) first comparing said packet loss percentage to a first threshold and
3 calculating said first threshold by evaluating the expression:
4 $\text{packet_loss_required} * (1 + \text{TH1})$
5 where $\text{packet_loss_required}$ is a programmable number representing the
6 desired maximum packet loss percentage and TH1 is a constant representing
7 a first hysteresis threshold;

PATENT

8 B) if said packet loss percentage is greater than or equal to said first
9 threshold, making the determination that a reduction in data rate is required and
10 proceeding to step 11;

11 C) if said packet loss percentage is not greater than or equal to said first
12 threshold, comparing said packet loss percentage to a second threshold and
13 calculating said second threshold by evaluating the expression:

14 $\text{packet_loss_required} * (1 - \text{TH2})$

15 where packet_loss_required is a programmable number representing the
16 desired maximum packet loss percentage and TH2 is a constant representing
17 a second hysteresis threshold;

18 D) if said packet loss percentage is less than or equal to said second
19 threshold, making the determination that an increase in data rate is required and
20 proceeding to step 11;

1 8. The process of claim 7 further comprising the steps:

2 if step D determines that said packet loss percentage is greater than said
3 second threshold, picking a new logical channel, and repeating the process steps in
4 claims 1 and 7 and this claim 8.

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1 9. A process for automatically altering the data rate on a logical channel with
2 changing noise conditions, comprising the steps:

3 1) resetting an average noise filter or accumulator or memory location for said
4 logical channel;

5 2) resetting a total packets received counter for said logical channel;

6 3) receiving a packet on said logical channel, and incrementing the total packet
7 received counter if said packet is not transmitted in response to a contention grant
8 and discarding said packet if it is transmitted in response to a contention grant;

9 4) processing a received packet to determine the average noise if the packet
10 has not been discarded and updating a running average noise value using the
11 average noise in the packet;

PATENT

1 2 5) comparing the count in said total packet counter to a number representing
1 3 the desired number of packets to be received before a determination of channel
1 4 signal-to-noise ratio is made;
1 5 6) if the number of packets received is less than the desired number, returning
1 6 to step 3;
1 7 7) if the number of packets received is equal to or exceeds the desired
1 8 number of packets received, calculating the signal-to-noise ratio (hereafter SNR) of
1 9 said logical channel;
2 0 8) comparing the SNR calculated in step 7 to one or more SNR thresholds;
2 1 9) determining if a change in data rate throughput is required based upon the
2 2 comparison(s) made in step 8;
2 3 10) if a change in data rate throughput is required, generating a signal
2 4 indicating the need for a change in data rate.

1 10. The process of claim 9 wherein step 8 through 10 comprise the following steps:
2 (A) determine the SNR of the logical channel and then determine if SNR
3 of the logical channel is less than the value $\text{SNR_REQUIRED} * (1 - \text{TH1})$ where
4 SNR_REQUIRED is the desired SNR for the logical channel and the burst profile
5 in use TH1 is a constant representing a first SNR threshold;
6 (B) if the SNR of the logical channel is lower than or equal to the value
7 $\text{SNR_REQUIRED} * (1 - \text{TH1})$, then reducing the data rate of said logical channel;
8 (C) if the SNR of the logical channel is greater than $\text{SNR_REQUIRED} * (1 + \text{TH2})$, then increasing the data rate of said logical channel.
9

1 11. The process of claim 10 wherein step (B) comprises reducing the data rate by
2 selecting the next burst profile down from the currently selected burst profile for the logical
3 channel being processed, said next burst profile down being selected from a table of burst
4 profiles arranged in order of ascending data rates.

1 12. The process of claim 10 wherein step (D) comprises increasing the data rate by
2 selecting the next burst profile up from the currently selected burst profile for the logical

PATENT

3 channel being processed, said next burst profile up being selected from a table of burst
4 profiles arranged in order of ascending data rates.

1 13. The process of claim 9 wherein step 10 comprises generating a signal which can
2 be seen or heard by an operator suggesting a change in data rate for the channel such that
3 said operator can manually select a new data rate and cause a new upstream channel
4 descriptor message to be generated and sent if the operators chooses to change the data
5 rate.

1 14. A process for automatically altering the data rate on a logical channel with
2 changing noise conditions, comprising the steps:

3 1) resetting a total uncorrectable codeword count for said logical channel for
4 an interval;

5 2) resetting a total codewords received count for said logical channel for said
6 interval;

7 3) receiving a burst on said logical channel, and adding the total codewords
8 received in the burst to the running total of codewords received for said interval;

9 4) receiving information regarding the number of uncorrectable codewords in
10 said received burst and adding said number of uncorrectable codewords to a running
11 total of uncorrectable codewords for the logical channel over said interval;

12 5) determining in any way whether said interval has been completed;

13 6) if said interval has not been completed, returning to step 3;

14 7) if said interval has been completed, calculating either the bit error rate or a
15 byte error rate of said logical channel;

16 8) comparing the error rate calculated in step 7 to one or more thresholds;

17 9) determining if a change in data rate throughput is required based upon the
18 comparison(s) made in step 8;

19 10) if a change in data rate throughput is required, generating a signal
20 indicating a need for a change in the data rate of said logical channel.

1 15. The process of claim 14 wherein step 8 comprises calculating the byte error rate
2 by evaluating the expression

3

$$(1) \text{ ByteErrorRate} = \frac{(T+1) * n_error}{(k + 2T) * n_total}$$

where

T is the number of maximum correctable bytes in an Reed-Solomon (hereafter R-S) codeword;

T+1 is T + 1, i.e., when there is an uncorrectable R-S codeword, there is a high probability of having T+1 flawed bytes;

n_error is the total number of uncorrectable R-S codewords for said interval from predetermined IUC burst type(s);

n_total is the total number of received R-S codewords from predetermined IUC burst type(s) received within said time interval;

k is the number of information bytes in an R-S codeword of a specific IUC; and

k+2t: the R-S codeword length in bytes;

and wherein the ByteErrorRate so calculated is compared to a byte error rate threshold.

16. The process of claim 14 wherein step 8 comprises calculating the byte error rate by evaluating the expression

$$(2) \text{ BER} = \frac{0.5 * (T+1) * n_error}{(k + 2T) * n_total}$$

where

T is the number of maximum correctable bytes in an Reed-Solomon (hereafter R-S) codeword;

T+1 is T + 1, i.e., when there is an uncorrectable R-S codeword, there is a high probability of having T+1 flawed bytes;

n_error is the total number of uncorrectable R-S codewords in a specific IUC burst within a certain time interval;

n_total is the total number of received R-S codewords of a specific IUC burst within a certain time interval;

k is the number of information bytes in an R-S codeword of a specific IUC; and

k+2t: the R-S codeword length in bytes;

and wherein the bit error rate so calculated is compared to a bit error rate threshold.

PATENT

1 17. The process of claim 14 wherein step (10) comprises reducing the data rate by
2 selecting the next burst profile down from the currently selected burst profile for the logical
3 channel being processed, said next burst profile down being selected from a table of burst
4 profiles arranged in order of ascending data rates and generating and transmitting
5 downstream and upstream channel descriptor message containing the parameters for
6 transmission on said logical channel including parameters which set said new data rate.

1 18. The process of claim 14 wherein step (10) comprises increasing the data rate by
2 selecting the next burst profile up from the currently selected burst profile for the logical
3 channel being processed, said next burst profile up being selected from a table of burst
4 profiles arranged in order of ascending data rates and generating and transmitting
5 downstream and upstream channel descriptor message containing the parameters for
6 transmission on said logical channel including parameters which set said new data rate.

1 19. The process of claim 14 wherein step 10 comprises generating a signal which
2 can be seen or heard by an operator suggesting a change in data rate for the channel such
3 that said operator can manually select a new data rate and cause a new upstream channel
4 descriptor message to be generated and sent if the operators chooses to change the data
5 rate.

1 20. A process comprising:

2 1) automatically determining the prevalent type of noise on a logical channel
3 and selecting a group of burst profiles suited to the type of prevalent noise on said
4 logical channel;

5 2) selecting an initial burst profile for said logical channel;

6 3) determining a quality of channel parameter for said logical channel;

7 4) comparing said quality of channel parameter to one or more thresholds;

8 5) determining based upon said comparison(s) made in step 4 whether a
9 change in bit rate on said logical channel is recommended.

10

PATENT

1 21. The process of claim 20 wherein step 2 comprises computing a signal-to-noise
2 ratio for said logical channel and selecting said initial burst profile based upon said signal-to-
3 noise ratio.

1 22. The process of claim 20 wherein step 3 comprises calculating a packet loss
2 percentage, signal-to-noise ratio, bit error rate or byte error rate.

1 23. The process of claim 20 wherein step 4 comprises comparing said quality of
2 channel parameter to an upper threshold limit, and, if said quality of channel parameter is less
3 than said upper threshold limit, comparing said quality of channel parameter to a lower
4 threshold limit.

1 24. The process of claim 20 further comprising the step of automatically selecting a
2 new burst profile with a higher or lower bit rate, as appropriate, if step 5 leads to a
3 conclusion that a new bit rate is recommended, and automatically generating and sending a
4 UCD message containing the burst parameters cable modems transmitting on said logical
5 channel must adopt for their upstream transmissions.

1 25. The process of claim 20 further comprising the step of generating a message to a
2 cable operator that a change in bit rate is recommended if step 5 leads to the conclusion that
3 a change in bit rate on said logical channel is recommended.

1 26. A process carried out in a cable modem termination system comprising the steps:
2 (1) powering up and measuring the signal-to-noise ratio (SNR) on a channel
3 prior to transmitting any downstream grant messages authorizing cable modems to
4 transmit on said channel;
5 (2) selecting an initial burst profile from a table of burst profiles appropriate to
6 said channel based upon a mode of operation of said channel, said selection based
7 upon said SNR of said channel;
8 (3) monitoring SNR of said channel and a rate that impulse noise is detected
9 on said channel;
10 (4) comparing the amount of impulse noise erasures to one or more erasure
11 thresholds and deciding whether said logical channel is dominated by Average White

PATENT

1 2 Gaussian Noise (AWGN) or impulse noise, and selecting an appropriate set of burst
1 3 profiles for said channel based upon the dominant noise type;

1 4 (5) after cable modems start transmitting on said channel, determining a
1 5 packet error rate for packets transmitted on said channel;

1 6 (6) comparing the packet error rate to one or more thresholds and deciding
1 7 whether a change in bit rate on said channel is advisable to bring said packet error
1 8 rate within predetermined limits;

1 9 (7) if a change in bit rate is indicated by step (6), automatically picking a new
2 0 burst profile with an appropriately changed bit rate from said set of burst profiles
2 1 selected in step 4.

1 27. The process of claim 26 wherein step 4 comprising comparing said amount of
2 impulse noise erasures to an upper limit threshold to determine when a channel has become
3 dominated by impulse noise, and comparing said amount of impulse noise erasures to a lower
4 limit to decide when said channel has become dominated by AWGN, said upper and lower
5 thresholds being separated by an amount sufficient to provide a hysteresis effect.

1 28. The process of claim 26 wherein step 6 comprising comparing said packet error
2 rate to an upper limit threshold to determine when a channel should have its bit rate lowered,
3 and comparing said packet error rate to a lower limit to decide when said channel should
4 have its bit rate increased, said upper and lower thresholds being separated by an amount
5 sufficient to provide a hysteresis effect.

1 29. The process of claim 26 wherein step 7 further comprises automatically
2 generating and sending an upstream channel descriptor message which includes parameters
3 set by said new burst profile so as to cause cable modems transmitting on said channel to
4 alter their bit rates.

1 30. The process of claim 26 wherein step 7 further comprises sending a message to
2 said cable operator indicating it would be desirable to manually change said bit rate.

1 31. The process of claim 26 further comprising the steps:

PATENT

2 (8) repeating steps 3 through 7 until either said packet error rate has been
3 brought within acceptable limits or a maximum number of attempts have been made;
4 (9) if a maximum number of attempts have been made without success in
5 bringing the PER within limits, jumping to another logical channel by sending new MAP
6 messages to all CMs that have been using the logical channel for which the PER
7 cannot be brought within limits instructing said CMs when they may transmit on the
8 new logical channel and, if necessary, sending an upstream channel descriptor
9 message defining the characteristics and burst profile of said new logical channel.

1 32. A cable modem termination system programmed to execute a media access
2 control process, and wherein:
3 said media access control process contains means for automatically sensing
4 the quality of a channel and making a decision regarding whether a change in bit rate
5 on said channel should be implemented based upon the quality of said channel.

1 33. The cable modem system of claim 32 wherein said means for automatically
2 sensing senses the quality of a channel by determining a quality factor related to the packet
3 error rate, and automatically selects a new bit rate and generates and sends an upstream
4 channel descriptor message to change the burst profile and bit rate appropriately for said
5 channel based upon changes in said packet error rate.

1 34. The cable modem system of claim 32 wherein said means for automatically
2 sensing senses the quality of a channel by determining a quality factor related to the packet
3 error rate, and automatically generates a message to advise a cable operator to manually
4 change the burst profile and bit rate appropriately for said channel based upon changes in
5 said packet error rate.
6